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Introduction to Dietary Planning

This report is one of a series of publications resulting from a comprehensive effort initiated by the Institute of Medicine's Food and Nutrition Board in 1993 to expand the approach to the development of dietary reference standards. The new categories of reference values have specific uses and thus are a significant departure from the previous Recommended Dietary Allowances (RDAs) in the United States and Recommended Nutrient Intakes (RNIs) in Canada. The focus of this report is to examine the appropriate use of each of the available types of Dietary Reference Intake (DRI) values in planning nutrient intakes of groups and individuals.

This report should be of particular use to nutrition and public health researchers in their work, to dietitians and nutritionists responsible for the education of the next generation of practitioners, and to the government professionals involved in the development and implementation of national diet and health assessments, public education efforts, and food assistance programs. The report reviews the statistical underpinnings for the application of the various types of DRI values in planning, illustrates sample applications, and provides guidelines to help professionals determine when specific uses are appropriate or inappropriate.

Planners need to have a good understanding of the DRIs, including how each requirement was derived, and whether the Tolerable Upper Intake Levels were based on all sources of nutrients or just fortificants and supplements. An understanding of basic statistics is also needed, especially for group planners. Planners must understand the concepts of risk and probability.

BACKGROUND

The term *Dietary Reference Intakes* (DRIs) refers to a set of nutrient-based reference values, each of which has special uses. The development of DRIs expands on the periodic reports called *Recommended Dietary Allowances* (RDAs), which have been published since 1941 by the U.S. National Academies, and the Canadian Dietary Standards, called *Recommended Nutrient Intakes* (RNIs) published since 1938 by the Canadian government. This comprehensive effort has been undertaken by the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes of the Food and Nutrition Board, Institute of Medicine, National Academies, at the request of the U.S. government and Health Canada.

A previous report in this series (IOM, 2000a) examined the use of DRIs in dietary assessment for individuals and groups. Dietary assessment, whether for an individual or a group, compares usual nutrient intakes with estimated nutrient requirements and examines the probability of inadequate or excessive intake. Dietary planning, on the other hand, aims for the consumption of diets that have acceptably low probabilities of inadequate or excessive nutrient intakes.


Dietary planning involves using the DRIs to set goals for what intakes should be.

Dietary planning may be done at several different levels. It may refer to an individual planning a meal and making relevant food purchases, a food service manager in an institution planning daily menus, or a government agency planning large nutrition or food assistance programs. For the purposes of this report, dietary planning applies to planning intake, rather than the amount of food purchased or served.

Nutritional considerations are only one component of dietary planning. Other considerations include incorporating food preferences of the individual or group being planned for, and the cost and availability of foods. However, using estimates of nutrient requirements to set intake goals should be part of the planning activity.

Figure 1-1 illustrates a conceptual framework described by Beaton (1994) that can be applied to the interpretation and uses of the DRIs. As shown in the framework, knowledge about both nutrient requirements and nutrient intakes feeds into two general applications: diet planning and diet assessment. Within each of these general categories, the applications differ according to whether they are for an individual or for population groups.
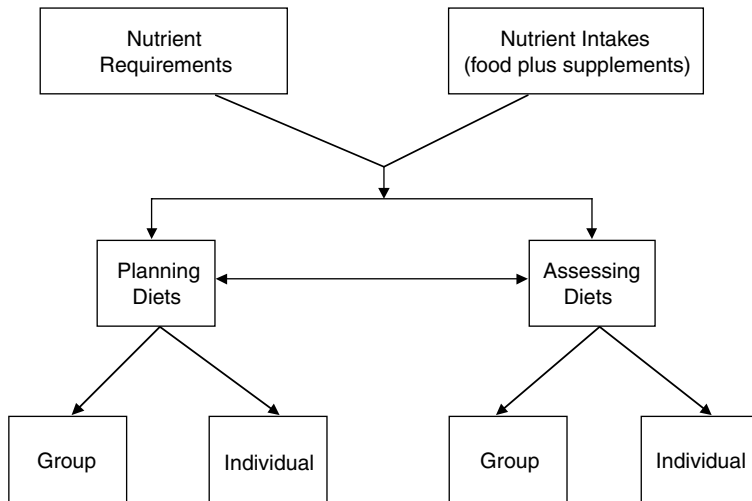
FIGURE 1-1 Conceptual framework—uses of dietary reference standards.
SOURCE: Adapted from Beaton (1994).

The simplicity of the above statements belies the complexity in using and interpreting DRIs to plan and assess diets. Two important factors account for this complexity. In the past, both planning and assessment applications have relied primarily on the former RDAs and RNIs because these were the only nutrient standards widely available. Often, the concepts underlying the former RDAs and RNIs were not well understood, and thus some applications for both assessment and planning purposes were inappropriate (IOM, 1994). Therefore, additional types of reference intakes have been developed (Estimated Average Requirement, Adequate Intake, and Tolerable Upper Intake Level). With the three additional categories of dietary reference intakes now available, applications need to be carefully considered and clearly explained so each of the categories are used appropriately. DRIs can be used in situations such as planning individual diets; planning nutrition and food procurement for the military, prisons, nursing homes, and other institutionalized groups; food labeling and nutritional marketing; clinical dietetics; food fortification; developing new or modified food products; and assessing food safety.

The approaches discussed in this report for using the DRIs as a guide in planning dietary intakes for individuals and for groups rely on the same basic principles that were presented in the previous report on applications of the DRIs in dietary assessment (IOM, 2000a). Those principles provide the rationale for using each of the DRIs for individual and group diet assessment, and the same rationale extends to the use of the DRIs in diet planning.

WHAT ARE DIETARY REFERENCE INTAKES?

As indicated above, the term *Dietary Reference Intakes* (DRIs) refers to a set of at least four nutrient-based reference values that can be used for planning and assessing diets and for many other purposes. An important principle underlying both the former Recommended Dietary Allowances (RDAs) and Recommended Nutrition Intakes (RNIs) and the new DRIs is that *these are standards for healthy people— they are not appropriate for individuals or groups who are ill or for repletion of deficient individuals.*

The concepts underlying the new DRIs differ from the former RDAs and RNIs as indicated in Box 1-1.

Processes Used to Establish the Dietary Reference Intakes

In establishing the EAR or Adequate Intake (AI) for nutrients, a requirement is defined as the lowest continuing intake level of a

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BOX 1-1 New Concepts Underlying the DRIs

• Where specific data on safety and a role in health exist, reduction in the risk of chronic degenerative disease or developmental abnormality, rather than just the absence of signs of deficiency, is included in the formulation of the recommendation.

• The concepts of probability and risk explicitly underpin the determination of the Estimated Average Requirement (EAR), RDA, and Tolerable Upper Intake Level (UL) and inform their application in assessment and planning.

• ULs are established where data exist regarding risk of adverse health effects.

• Compounds found naturally in food that may not meet the traditional concept of a nutrient but have potential risk or possible benefit to health are reviewed, and if sufficient data exist, reference intakes are established.

nutrient that will maintain a defined level of nutriture in an individual. The chosen criterion of nutritional adequacy upon which this requirement is based is different for each nutrient and is identified in the DRI nutrient reports (IOM, 1997, 1998a, 2000b, 2001, 2002a). In some cases, the criteria may differ for individuals at different life stages for the same nutrient. In developing the DRIs, emphasis is placed on the reasons underlying the particular criterion of adequacy used to establish the requirement for each nutrient. A more detailed discussion of the origin and framework of the DRIs is presented in Appendix A.

The EARs are based on a thorough review of the scientific literature for health outcomes associated with the nutrient. The criteria and evidence-based rationale used for setting each EAR are clearly specified. An estimate of the variation in the requirement is also specified, and is used to set the RDA. When data are inadequate to establish an EAR and RDA, other approaches are used to establish an intake goal, which is designated an AI. The process used to establish the UL involves the estimation of an uncertainty factor that is applied to a no-observed-adverse-effect level (NOAEL) or to a lowest-observed-adverse-effect level (LOAEL) based on human or animal data related to identified hazards.

Estimated Average Requirement[1]

The *Estimated Average Requirement* (EAR) is the usual intake level that is estimated to meet the requirement of half the healthy individuals in a life stage and gender group. At this level of intake, the other half of the healthy individuals in the specified group would not have their needs met. The EAR is based on a specific criterion of adequacy, derived from a careful review of the literature. When selecting the criterion, reduction of disease risk is considered along with many other health parameters. For example, the EAR for vitamin C is based on "an amount thought to provide antioxidant protection as derived from the correlation of such protection with neutrophil ascorbate concentrations" (IOM, 2000b). For energy,

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[1] It is recognized that the definition of EAR implies a median as opposed to a mean or average. The median and average would be the same if the distribution of requirements followed a symmetric distribution, and would diverge as the distribution became skewed. Two considerations prompted the choice of the term EAR: (1) data are rarely adequate to determine the distribution of requirements, and (2) precedent has been set by other countries that have used the term EAR for reference values similarly derived (COMA, 1991).

the situation is somewhat different. Energy requirements are estimated on an individual basis using a person's gender, age, height, weight, and physical activity level to estimate total energy expenditure; thus the specific criterion of adequacy is maintenance of a healthy body mass index with a healthy level of physical activity.

Recommended Dietary Allowance

The *Recommended Dietary Allowance* (RDA) is the dietary intake level that is sufficient to meet the nutrient requirement of nearly all healthy individuals in a particular life stage and gender group. If the distribution of requirements in the group is assumed to be normal, the RDA is computed from the EAR by adding two standard deviations of the requirement (SD_{REQ}) as follows:

$$RDA = EAR + 2 \ SD_{REQ}$$

The standard deviation of the requirement distribution can be observed directly if sufficient data are available. Often this is not the case, and the standard deviation is estimated by assuming a specific coefficient of variation (CV) for the average requirement. A CV of 10 percent has been used for many nutrients (IOM, 1997, 1998a, 2000b, 2001), and for these, the RDA equals 120 percent of the EAR. Therefore, assuming a normal distribution, 97 to 98 percent of the individuals in the group will have a requirement that is below the RDA. If the distribution of requirements is known to be skewed rather than normal (for example, iron requirements of menstruating women), the RDA is obtained by finding the usual intake level that is at the 97th to 98th percentile of the requirement distribution. In either case, the RDA developed in the DRI process differs conceptually from the former RDAs and RNIs since with the establishment of an EAR, the RDA is determined quantitatively rather than through the use of judgment-based safety factors.

The RDA is intended for use primarily as a goal for intake of individuals. Because the RDA is often derived directly from the EAR and an estimate of variability of the requirement distribution, if data are insufficient to establish an EAR, no RDA can be set.

Adequate Intake

If sufficient scientific evidence is not available to establish an EAR, and thus determine an RDA, a reference intake called an *Adequate Intake* (AI) may be derived instead. The AI is a value based on

experimentally derived levels of intake or the mean nutrient intake by a group (or groups) of apparently healthy people who are maintaining a defined nutritional state or criterion of adequacy. Examples of defined nutritional states include normal growth, maintenance of normal circulating nutrient values or biochemical indices, or other characteristics of nutritional well-being or general health related to the nutrient.

For example, the AI for young infants is based on the daily mean nutrient intake supplied by human milk for healthy, full-term infants who are exclusively breastfed. For adults, the AI may be based on data from a single experiment (e.g., the AI for choline [IOM, 1998a]), on estimated dietary intakes in apparently healthy population groups (e.g., the AI for pantothenic acid [IOM, 1998a]), or on combined data from different approaches (e.g., usual dietary intake and experimentally altered intakes of calcium in adult women [IOM, 1997]). The AI is thus expected to exceed the true EAR (and often the RDA) if it could be set for the same specified criterion of nutritional adequacy. In the absence of an EAR (and RDA) for a nutrient, the AI can be used as the intake goal.

The issuance of an AI is an indication that more research is needed to determine with confidence the mean and distribution of requirements for a specific nutrient. As this research is completed, it should be possible to replace estimates of AIs with EARs and RDAs.

Tolerable Upper Intake Level

The *Tolerable Upper Intake Level* (UL) is the highest level of continuing daily nutrient intake that is likely to pose no risk of adverse health effects to almost all individuals in a specified life stage and gender group. As intake increases above the UL, the potential risk of adverse health effects increases. The term *tolerable intake* was chosen to avoid implying a possible beneficial effect from levels of intakes above the RDA. Instead, the term is intended to connote a level of intake that can, with high probability, be tolerated biologically. The UL is not a recommended level of intake, and there is no currently established benefit to healthy individuals associated with ingestion of nutrients in amounts exceeding the RDA or AI.

The UL is based on an evaluation conducted using the methodology for risk assessment of the adverse effects of nutrients (IOM, 1999). (A detailed explanation of this methodology is also included in all of the DRI nutrient reports.) The need to establish ULs grew in part out of the increased fortification of foods with nutrients and the increased use of dietary supplements. Details are given for each

nutrient on how the UL was established (IOM, 1997, 1998a, 2000b, 2001, 2002a). For some nutrients there may be insufficient data on which to develop a UL. The lack of a UL cannot be interpreted as meaning that high intake poses no risk of adverse effects.

Unless otherwise stated in the DRI nutrient reports, values given for EARs, RDAs, AIs, and ULs are based on the total intake of the nutrient naturally occurring in food, added to food as a fortificant, and from supplements.

IMPLEMENTATION OF DIETARY PLANNING FOR INDIVIDUALS AND GROUPS

Planning diets refers to determining what usual nutrient intake should be. Regardless of whether one is planning diets for individuals or groups, the goal is to have diets that are nutritionally adequate, or conversely, to ensure that the probability of nutrient inadequacy or excess is acceptably low. As will be described in depth in this report, how this goal is implemented differs when planning for individuals compared to planning for groups. Nevertheless, the underlying considerations are similar.

At the individual level, usual intake is defined as the individual's average intake over a long period of time. As discussed in greater detail in the Dietary Reference Intake (DRI) report on dietary assessment (IOM, 2000a), because of the large day-to-day variation in individual intake, intake on one or even several days may provide inaccurate estimates of an individual's usual intake. Similarly, for groups, the focus for diet planning is the distribution of usual intake, which is the distribution of the long-term average intakes of individuals in the group. Usual intake distributions can be estimated by adjusting the observed intake distributions using statistical techniques (NRC, 1986; Nusser et al., 1996). By removing the day-to-day variation in intakes (within-person variation), the resulting adjusted distribution better reflects the individual-to-individual variation of intakes within the group.

Another consideration in the implementation of dietary planning is the concept of an acceptably low probability of nutrient inadequacy (probability that intake does not meet requirement) or, conversely, a high probability of nutrient adequacy. For individuals, an acceptably low probability of nutrient inadequacy has been traditionally accomplished by planning for the individual's usual intake to be at the Recommended Dietary Allowance for the nutrient, such that the probability of inadequacy does not exceed 2 to 3 percent.

To date, planning for groups has generally not incorporated planning for a low prevalence of nutrient inadequacy, in large part because the tools required (knowledge of the Estimated Average Requirement and the usual intake distribution) have not been widely available. Thus, there is no convention about what prevalence of inadequacy is acceptably low. It is in the professional judgment of the nutritionist or planner to determine what is an acceptably low probability of nutrient inadequacy for an individual or prevalence of inadequacy for groups. The level selected should be clearly stated. Similarly, in applying the DRIs for planning, professional judgment is required to determine the likelihood of any recognized benefit of increasing intakes beyond their current level.

CAVEATS REGARDING THE USE OF DIETARY REFERENCE INTAKES IN DIETARY PLANNING AND ASSESSMENT

Dietary planning and assessment are inextricably linked. Assessment is used as a basis for planning and to evaluate whether the planning goals have been met. Those assessing and planning diets should be aware of limitations in the data that underpin the Dietary Reference Intakes (DRIs) and their application: there is uncertainty associated with the estimates of the Estimated Average Requirements (EARs) themselves, and dietary intake and food composition data are subject to inaccuracy.

Limitations in the Data on Nutrient Requirements

Detailed consideration of the DRI reports for specific nutrients (IOM, 1997, 1998a, 2000b, 2001, 2002a) can provide insight into both what is known and what information is still needed to further define intakes that support health. In interpreting the DRIs for use in dietary planning, planners should be aware that often the EARs are based on data from a limited number of individuals; that for most nutrients the precise variation in requirements is not known and has been approximated from the variation in related physiological parameters; that, in the absence of evidence to the contrary, the variation in individual requirements has been assumed to follow a normal distribution; that the EAR has often been extrapolated from one population group to others that differ in life stage and gender; and that the degree of uncertainty associated with the EAR has not been specified. By definition, EARs are estimates—they are not defined with 100 percent accuracy. Thus, although the best available evidence was used, gaps in the knowledge base remain.

Choice of Requirement Criterion

Knowledge of the criterion used by the DRI panels to determine the EAR and Recommended Dietary Allowance (RDA) can help in assessing the potential impact of not meeting these guidelines. This may affect setting goals for nutrient intake, including selection of an acceptable group prevalence of dietary inadequacy (e.g., the proportion of a group with intakes below the EAR).

In establishing the DRIs, the requirements for most nutrients have been presented as a single endpoint for various life stage and gender groups, rather than as multiple endpoints. To the extent that for most nutrients a single endpoint has been established for an EAR and RDA, this approach differs from that originally recommended by NRC (1986) and adopted by the Joint Food and Agriculture Organization and World Health Organization Expert Consultation on the requirements of vitamin A, iron, folate, and B_{12} (FAO/WHO, 1988). These groups recommended both a basal requirement level (the amount of nutrient needed to prevent a clinically detectable impairment of function) and a normative storage requirement level (the amount of nutrient needed to maintain a desirable level in tissues). However, the DRI process does allow for multiple endpoints to be used where the data exist, and to date this has been done for vitamin A. An EAR has been set for the reversal of night blindness, and an EAR and RDA have also been set for the maintenance of liver stores. A planner might want to ensure that intakes would result in a minimal (near zero) prevalence of inadequacy with regard to night blindness, but might be willing to accept, and thus plan for, a somewhat higher prevalence of inadequacy with regard to maintenance of normal liver stores.

Inadequate Dietary Intake Versus Inadequate Nutritional Status

Planning diets for groups involves choosing an acceptable group prevalence of dietary inadequacy (see Chapter 3). Theoretically, this would correspond to the prevalence of inadequate nutritional status with regard to the criterion used to establish the EAR. For example, if planners chose to maintain the current distribution of vitamin B_6 intake in the United States in women aged 31 to 50 (see appendixes to the DRI publications for tables describing the population distributions of nutrient intakes [IOM 1997, 1998a, 2000b, 2001, 2002]), they would be accepting an apparent group prevalence of dietary inadequacy between 10 and 15 percent, according to data from the Third National Health and Nutrition Examination

Survey (NHANES III). If the assumptions involved in establishing the EAR were correct and applied to all population groups, one would expect to observe similar proportions consuming vitamin B_6 below the EAR and with low plasma pyridoxal phosphate levels (i.e., inadequate nutritional status with regard to the indicator used to set the EAR). In practice, however, the apparent prevalence of *dietary inadequacy* of a nutrient may not be equivalent to the prevalence of *inadequate nutritional status* for the same nutrient.

Sources of error contributing to any observed discrepancies between estimates of the prevalence of inadequate intake and inadequate nutritional status include those involved in estimating dietary intakes. These have been reviewed in the DRI report on dietary assessment (IOM, 2000a), and include an incomplete knowledge of (1) the nutrient composition of foods, (2) the nutrient bioavailability from different food and supplemental sources, (3) the usual intakes as compared with short-term intakes, and (4) the underreporting of self-reported dietary intakes. The uncertainties involved in estimating nutrient requirements can also contribute to observed discrepancies, as can the lack of population data on the biochemical indicators of nutrient adequacy used to establish the requirement estimates.

Sources of Error in Planning for Dietary Intake

Uncertainty of Requirement Estimates

For some nutrients, the sources of error in estimating intakes and requirements are not extreme, and the apparent prevalence of dietary inadequacy (e.g., the proportion below the EAR) corresponds reasonably well to the prevalence of inadequate nutritional status with regard to the criterion used to establish the EAR. For example, the EAR for iron was established as the amount of iron needed to meet body functions with minimal storage, and this was determined to be reflected by a serum ferritin concentration of about 15 µg/L (IOM, 2001). When the prevalence of inadequate iron intakes was compared to the prevalence of apparent biochemical deficiency (low serum ferritin concentrations), the agreement was reasonable for most life stage and gender groups (IOM, 2001). If planners chose to reduce the prevalence of dietary inadequacy (and, by inference, the prevalence of inadequate nutritional status), this could be done using the methods described in Chapter 3 of this report.

In other cases, however, errors in estimating dietary intake make it difficult to use dietary intake data to plan diets with acceptable levels of inadequacy. This is especially true for vitamin E. Food composition data need to be updated for this nutrient, and dietary intakes are frequently underestimated due to underreporting (which may be particularly problematic for fat, a major carrier of vitamin E) (Mertz et al., 1991). Data from NHANES III suggest that the majority of adults aged 31 to 50 had apparently inadequate dietary intakes (IOM, 2000b), leaving the impression that diets must be planned with additional vitamin E to meet the requirements for the population. However, examination of the serum α-tocopherol distributions in NHANES III reveals that fewer than 5 percent had plasma concentrations below the 12 μmol/L (516 μg/dL) used to set the EAR. Thus, for vitamin E, it is clear that the apparent prevalence of dietary inadequacy does not correspond to the prevalence of inadequate nutritional status as assessed biochemically. Thus, when choosing a planning goal, especially when planning for groups, planners need to consider the limitations of the dietary intake data, the consequences of not meeting the criterion used to determine the EAR, the results of available biochemical data, and the goals of dietary planning for specific situations.

As indicated earlier, a nutrient will usually have a Tolerable Upper Intake Level and either an EAR and RDA or an Adequate Intake (AI). However, for energy and the macronutrients, this is not always the case. For example, no DRIs have been set for total fat for individuals over 1 year of age. Instead, an Acceptable Macronutrient Distribution Range of 20 to 35 percent of energy from dietary fat is recommended for adults to minimize risk of adverse health outcomes. For energy, no DRIs have been set—an estimate of the total energy expenditure associated with an individual's gender, age, height, weight, and physical activity level is used.

Uncertainty of Dietary Intake Estimates

Another source of error that has potentially profound implications for dietary assessment and planning is the accuracy of self-reported dietary intakes. A variety of study designs has been employed to examine the accuracy of dietary assessment techniques to measure individuals' true energy intakes over defined time periods. The weight of evidence from this extensive literature indicates that a sizeable proportion of individuals systematically misreport their intakes, with the tendency toward underreporting. In a now classic study by Mertz and colleagues (1991), the usual energy intake of

266 adults (estimated from 7 to 35 days' worth of food records) was determined to be insufficient to maintain body weight in 81 percent of subjects. The average discrepancy between self-reported energy intake and the intake required for weight maintenance was 700 kcal. More recently, self-reports of dietary intake have been compared to energy expenditure measured by doubly labeled water, on the assumption that energy expenditure is equivalent to intake in situations of energy balance. Such comparisons have typically revealed substantial underreporting of intakes, even when changes in body stores during the study period are taken into account (Bandini et al., 1990; Black et al., 1993; Johnson et al., 1998; Kaczkowski et al., 2000; Martin et al., 1996; Prentice et al., 1986; Tomoyasu et al., 1999). Furthermore, although the nature and sources of measurement error are known to vary across dietary assessment methods, the problem of underreporting appears to be pervasive irrespective of whether food records, dietary recalls, diet histories, or food frequency questionnaires are used to assess intake (Black et al., 1991; Sawaya et al., 1996).

Self-reports of dietary intake have also been compared to estimates of energy expenditure based on factorial methods, although at the individual level, this method yields a less precise estimate of energy expenditure than the doubly labeled water technique. Typically, reported energy intake (EI) is expressed as a ratio of estimated basal metabolic rate (BMR_{est}), based on age, sex, self-reported or measured body weight, and possibly height. A variety of approaches to evaluating the adequacy of EI/BMR_{est} can be found in the literature. Goldberg and colleagues (1991) have proposed a method to estimate a minimum plausible EI/BMR_{est} by applying a series of assumptions that take into account within-person variation in energy intake, random error in the estimation of an individual's basal metabolic rate based on the predictive equation used, and variation in an individual's physical activity level. When these methods have been applied to population-based dietary survey data, comparisons indicate that 10 to 50 percent of respondents may be underreporting their food (energy) intakes (Black et al., 1991; Briefel et al., 1997; Johansson et al., 1998; Stallone et al., 1997).

While the underreporting of energy intakes appears well documented, it is unclear how this affects the accuracy of self-reported *nutrient* intakes. Research into this question is limited by the absence of reliable reference biomarkers for intakes of many nutrients. Studies in which the assessment of self-reported energy intake using the doubly labeled water method has been combined with the measurement of urinary nitrogen excretion to assess self-reported protein

intake suggest that energy intake may be more prone to under-estimation than protein intake (Larsson et al., 2002). Importantly, these findings imply that all nutrients are not proportionally under-reported; rather, particular foods or classes of foods must be selec-tively underreported. When the reported intakes by individuals classed as energy underreporters have been compared to those whose energy intakes appear more plausible, underreporters have often been found to report a lower percentage of energy from fat (Becker and Welten, 2001; Becker et al., 1999; Briefel et al., 1997; Goris et al., 2000). Such comparisons have also indicated lower reported consumption of particular classes of foods among under-reporters (Becker and Welten, 2001; Krebs-Smith et al., 2000). How much one can infer about the nature of underreporting from these studies hinges on the validity of the assumption that underreporters' dietary patterns are the same as those not deemed to be under-reporting. Nonetheless, it would appear overly simplistic to assume that the nutrient intakes of individuals who systematically under-report their energy intakes are underreported to the same degree.

The implications of underreporting for dietary assessment and planning are profound given the need to rely on self-reported dietary intakes for information about usual intake patterns. Because individuals' intakes of energy and nutrients are intertwined, the systematic underestimation of true usual energy intakes for some proportion of the population is likely to mean an underestimation of nutrient intakes as well. This is illustrated in a recent analysis of data from a Swedish population survey in which the proportion of individuals with nutrient intakes below the average requirement decreased substantially when individuals reporting "implausibly or dubiously low energy intakes" (defined as $EI/BMR_{est} < 1.10$ and 1.10 to 1.34, respectively, with EI estimated from a 7-day food record) were excluded from the analysis (Becker and Welten, 2001).

Planners are currently limited as to what they can do to correct problems of underreporting. The application of EI/BMR_{est} thresh-olds to identify underreporters can be problematic, given the need to make assumptions about individuals' usual physical activity levels (often in the absence of good measures of physical activity) and the error inherent in estimates of BMR (an error that is compounded when BMR is calculated using self-reported weight and height). Further, it cannot be assumed that all those with reported energy intakes above the chosen EI/BMR_{est} threshold have accurately reported their intakes. Even if underreporters are somehow identi-fied, the exclusion of their data from population-level assessments of nutrient adequacy clearly threatens the ability to generalize assess-

ment results to the population as a whole. This is because it cannot be assumed that the diets of individuals identified as underreporters are identical to those not so identified.

Well-accepted, validated methods to statistically correct for the effects of underreporting on the estimated distribution of usual intakes are presently lacking. The statistical procedures proposed to adjust intake distributions for within-person variation in intake (e.g., NRC, 1986; Nusser et al., 1996) do not correct for systematic errors in reporting. Application of the residual method of energy adjustment (Willett and Stampfer, 1986) to nutrient distributions has been proposed as one means to reduce the bias associated with energy underreporting without excluding the data of underreporters in some kinds of epidemiological analyses (Stallone et al., 1997). This adjustment method, however, does not provide an appropriate correction of underreporting for dietary intake data to be used in assessment and planning applications of the DRIs. Energy adjustment methods cannot eliminate bias due to selective underreporting of foods; instead these methods effectively "assume" that nutrients have been underreported in direct proportion to energy. Further, energy adjustment does not provide corrected estimates of absolute intake. Thus, energy-adjusted data are not useful in assessments of nutrient adequacy.

In summary, energy underreporting is clearly a serious problem in dietary surveys; it limits the accuracy with which planners can estimate usual energy and nutrient intakes in population groups of interest. Given the current absence of inexpensive, validated methods to readily identify underreporting in dietary intake surveys and statistical methods to correct for underreporting in self-reported energy and nutrient intakes, planners are severely limited in their ability to address this problem.

This problem not only highlights the importance of employing thorough, standardized procedures to collect dietary data, but it also flags the urgent need for more research into statistical methods to analyze and adjust for underreporting in self-reported intake data. In interpreting the results of dietary assessments prior to determining planning goals, planners should look to other sources of data on nutritional status (e.g., anthropometric, clinical, or biochemical assessments) for corroborating evidence. In interpreting dietary assessment results, planners may also find it useful to estimate the extent of energy underreporting in their data by applying factorial methods to compare reported energy intakes with estimates of energy expenditure. However, the crudeness of these estimates should be recognized. Until better methods of identification and

adjustment are developed, it is not recommended that data adjust-
ments be undertaken.

Planners can use dietary intake data from national surveys, but
should remain aware of the inaccuracies of the data when setting
intake goals based on the DRIs and assessing achievement of those
goals.